Microbial-Explicit Processes and Refined Perennial Plant Traits Improve Modeled Ecosystem Carbon Dynamics

CABBI
CENTER FOR ADVANCED BIOENERGY AND BIOPRODUCTS INNOVATION

Background/Objective

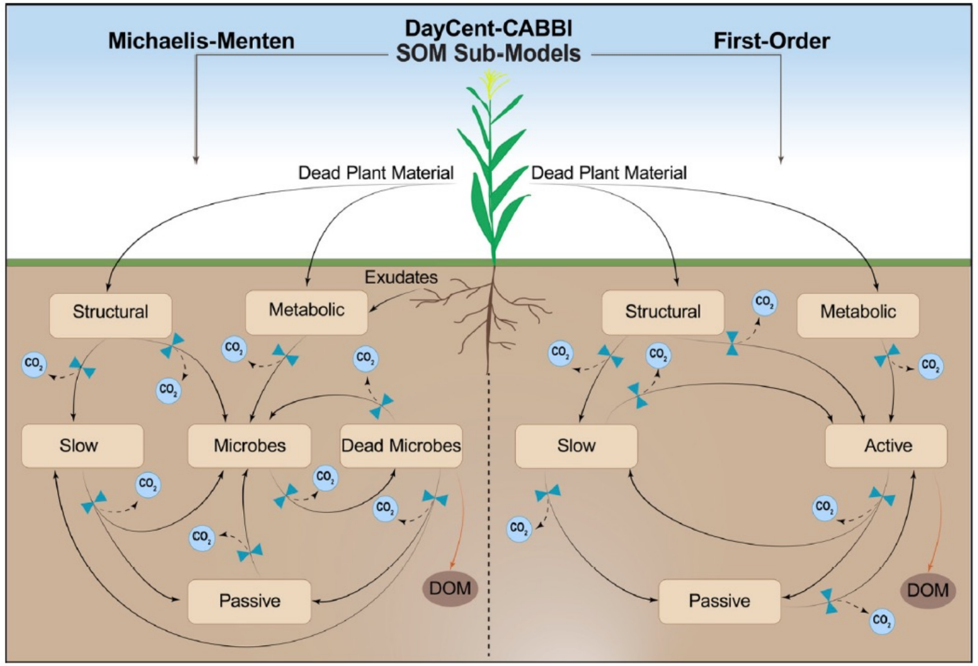
- Understanding how soil carbon (C) dynamics are influenced by factors including climate, vegetation, management, and disturbance is essential for evaluating policy related to net C balance. While soil microbes play a key role in C fluxes and stabilization, biogeochemical models often do not address microbial-explicit processes.
- This work adds microbial-explicit processes into the DayCent biogeochemical model to better represent mechanisms of soil C formation and stabilization and a new plant type to better represent large perennial grass structural complexity and life history.

Approach

Researchers developed a Michaelis Menten (MM) soil organic matter (SOM) DayCent sub-model to represent microbial-explicit processes and further parameterized and validated a recently-developed plant sub-model that better represents large perennial grass chemistry and physiology. They compared the new MM model to the original first order (FO) model under simulated potential future climate conditions.

Results

The MM sub-model represented seasonal dynamics of soil C fluxes better than the FO sub-model, which consistently overestimated winter soil respiration. While both sub-models were similarly calibrated to total, physically protected, and physically unprotected soil C measurements, they differed in future soil C response to disturbance and climate, most notably in the protected pools.



DayCent-CABBI soil sub-model pool structures and C flows between pools for MM and FO models. Solid arrows show direction of C flow between pools. Bowties indicate decomposition and CO_2 loss. Red arrows indicate leaching as dissolved organic matter.

Significance/Impacts

These modeling advances benefit not only CABBI but also the greater community of researchers and stakeholders who want to estimate the carbon intensity of growing high-yielding perennial grasses for biofuel and bioproduct production.

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